63-2-3

PROGRESS REPORT

ON

AF 33(657)-7851

"DESIGN CRITERIA FOR RADIATION RESISTANT

FLIGHT CONTROL SYSTEMS FOR AEROSPACE VEHICLES"

Period Covered: 1 April — 30 April 1962

BPSN 2(1-8222)82288

1. Technical Areas

The description of technical effort will be divided into the six major areas to facilitate presentation of accomplishments.

A. Determination of Flight Control System

A typical flight control system has been listed and broken down into components. The components chosen were those most commonly used in systems; the choice was not based on radiation sensitivity (or lack of it). This breakdown has been incorporated in rough report form, and accompanies this progress report under separate cover. The effort in this area is 90% complete; only minor changes are anticipated in the previously mentioned system breakdown.

B. Definition of Radiative Environment

The definition of the space radiative environment has been completed; the only changes anticipated will be those of incorporation of new data as it becomes available, and a small effort on solar flares. The determination of time variance and isotropy of solar cosmic ray events is not as rigorous as desired; this will involve a relatively minor effort with no major problems anticipated. The American Geophysical Union meeting, Washington, D. C., April, was attended by M. Chapman; information obtained on the Van Allen belt electron fluxes, and solar flare particles, was very useful in definition of the space environment. The effort expended in this area is 90% of the total effort contemplated.

C. Determination of Radiation Penetration Through Satellite Walls

With the completion of the initial definition of the radiative environment, the proton penetrations for the specific trajectories can be calculated and will be completed next month. While the assumed .274 gm/cm^2 (.040") aluminum holds true for roughly 2π steradians, some cri-

terion will be developed to approximate the shielding over the remaining 2π steradians. Some representative material in a typical amount will be assumed in a simple geometry and a correction made for nonhomogeneity. A calculation will be made of $E - dE/dx\ \Delta x$ for the primitive proton spectrum through .274 gm/cm^2 of aluminum over the appropriate solid angle. Then using the proton shielding program in NSL 62-81 (Reprint from NOR 61-116) to evaluate the filtered spectrum from the remaining solid angle, the proton spectrum (with some neutrons) will be determined which will be typical of the environment for a component or piece part adjacent to the .040" skin. This will be the environment utilized for the initial appraisal of radiation effects on flight control system components. Later the spectrum typical of components in the center of the equipment compartment will be determined (although it will be less severe).

The $-1/\rho\ dE/dx$ for relativistic electrons has been programmed and run on the IBM 7090. The general outline for the bremsstrahlung production has been established but has not been programmed. A bremsstrahlung production program (card deck and test case) has been received from W. M. Schofield of Lockheed Nuclear Products. Ths program has been run on Northrop's IBM 7090 and is currently being appraised to determine which will be more expedious, completing the Northrop bremsstrahlung program or adapting Lockheed's program to the thin wall (.040") assumed for this contract.

The effort expended in this area is approximately 30% of the total effort contemplated. The initial effort in this area should be completed next month and summarized in a report to accompany the 5th monthly progress report.

D. Determination of Radiation Damage Criteria

The initial study of basic damage mechanisms has been completed. A survey of experimentally observed radiation damage to typical flight control system materials and components is in progress (see paragraph of this report). There is a large quantity of radiation effects data on specific devices and materials subjected to specific test conditions. However, the survey of such material is not straightforward. In many cases tested devices have become obsolescent. Also, variation in component characteristics such as vagaries of manufacture, deliberate change in materials and use in new combinations have been noted. The uncertainties involved in extrapolating actual test conditions to the presumed conditions of use of a material or device can be great.

E. Determination of Radiation Effects on Flight Control Systems

The bibliography on radiation effects on flight control system components is being constructed. Investigation of damage thresholds for the components will be initiated soon. The effort expended in this area is approximately 5% of the total effort.

F. Test Program Analysis and Planning

The literature search was continued on irradiation facilities, dosimetry, and test procedures with the effort expended approximately 6% of the total effort.

April